CO_2 ADSORPTION ON AMINE-FUNCTIONALIZED PERIODIC MESOPOROUS SILICA AND ORGANOSILICAS

Setnickova K., Sabata S., Strasak T., Soukup K.

Institute of Chemical Process Fundamentals of the CAS, v. v. i., Rozvojova 2/135, CZ-165 02 Prague 6 – Suchdol, Czech Republic

Nowadays, the reduction of CO_2 emission became the key issue to slow down the global warming. Recently, various adsorption techniques and materials for CO_2 capture have been developed. For decades the amine-containing materials such as liquid amines have been used in industrial processes to capture CO_2. Nevertheless, this process possesses several disadvantages, including high cost and high energy consumption associated with evaporation of CO_2. As a result, the research on the CO_2 capture is gradually shifting from liquid amine-based scrubbing to solid adsorption to overcome these drawbacks. Mesoporous silica is a very popular solid adsorbent for gas- and liquid-phase applications including CO_2 sorption. Recently, porous solid adsorbents such as silica have been modified by the amine-containing compounds to increase their affinity toward CO_2.
Herein, CO_2 adsorption was investigated on amine-functionalized mesoporous silica and periodic mesoporous organosilica samples. Hexagonally ordered mesoporous SBA-15 and benzene-PMO (BPMO) samples were prepared and functionalized by amine-containing modifier TSPED (N-[3-(trimethoxysilyl)propyl]-ethylenediamine). Nitrogen adsorption isotherms showed that these samples featured mesostructured, high surface area, and narrow pore size distributions. N-[3-(trimethoxysilyl)propyl]-ethylenediamine-modified silica samples exhibited substantially higher CO_2 uptake compared to original material; maximal values for SBA-15_A ∼3.1 mmol/g, for BPMO_A ∼3.0 mmol/g and SBA-15-BTEP_A ∼2.9 mmol/g, measured on a volumetric adsorption analyzer at 25 °C. The amine-modification also significantly improved the CO_2/N_2 separation properties of all prepared silica samples (e.g. SBA-15 from 14 to 86 for pressure 1 bar).

Acknowledgement
This work was supported from the Czech Science Foundation project no. 19-23760J.